Fifth Year Work Plan

Validation of CERES Cloud Retrievals over the Arctic with Surface-Based Millimeter Wave Radar - Uttal, Matrosov, Frisch, Minnis, Baum

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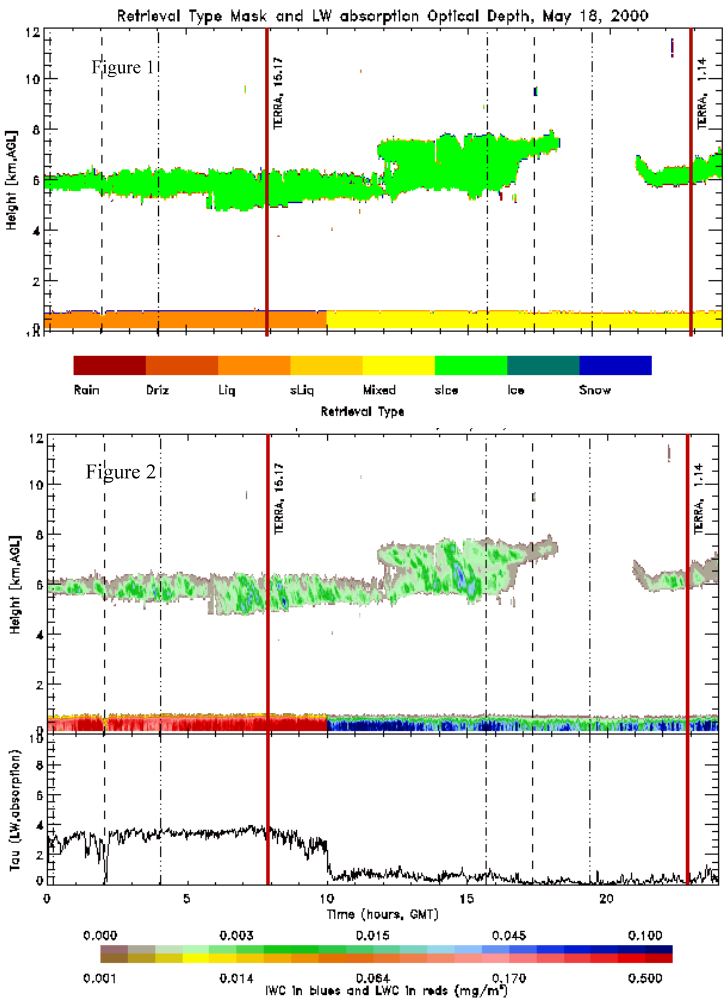
Radar-radiometer based cloud retrievals for the Barrow, Alaska DOE/ARM/CART, are available through the internet at http://www.etl.noaa.gov/arctic and will from the basis of the 5th year work. At the time of this report, March-December of 2000 has been processed and posted, and January-April and August of 2001 will be completed by the end of September 2001. It is expected that quality retrievals for May, June and July of 2001 will not be possible because of millimeter cloud radar operating problems during those months. Figure 1 shows an example of a cloud classification mask that are developed for a representative cloud scene; it is on these basis of such classification masks that the appropriate ice, liquid, or mixed retrieval to run for each part of the cloud (Note that TERRA and NOAA-12, 14,15 and 16 overpasses are indicated). Figure 2 shows retrieval results for simultaneously occurring liquid and ice clouds, with ice water contents in blue/green, and liquid water contents in orange/red. These figures also indicate problems with current calculations of optical depths. In this particular example, the lower cloud was classified as liquid between 0 and 10 GMT, changing to mixed phase between 10 and 24 GMT, with the upper level cloud classified as ice for the entire period. The present algorithms will only do ice retrievals for a mixed phase cloud since the radar returns are heavily weighted to signal from the larger ice particles in mixed phase clouds. Figure 2 illustrates the discontinuity in calculated optical depths which results from the fact that the algorithms are no longer accounting for the contribution from the liquid phase in the cloud after 18:00 GMT. The following tasks will be performed in the 5th year:



(1) Improve calculations of optical depth for mixed phase clouds, as well as implement additional radar only (as opposed to radar-radiometer) retrieval techniques to increase the number of situations in which ground based retrievals can be implemented.

(2) Continue to update the NSA web site with retrieval information in "near real-time", with a target of keeping retrievals current on a weekly basis. These retrievals will be continually refined, and additional information will be provided on the reliability of the retrievals and the techniques in involved in the retrievals. Classify the ground-based cloud data sets into overpass centered subsets including i) ice-only ii) liquid only iii) mixed phase iv) single-layer v) optical depth bins.

(3) Continue work on radiative transfer calculations with a combination of the CSU/GCM radiation code and a STREAMER type code to assess the radiative importance of different kinds of Arctic clouds. Although this work takes advantage of the range-resolved cloud measurements from the ground-based sensors that are not available with the TERRA instruments, it will continue to provide guidance on the cloud types that have the most significant impact on the Arctic atmospheric radiation budgets. Several activities are planned for the coming year, including a vigorous effort to compare BUGSRad fluxes to other radiative transfer models and to observations. We will also study and characterize the radiative impact of complex cloud systems, which include mixed phase clouds and multi-layer clouds. Another important aspect to be addressed is to compare the role of characteristic particle size. As noted many models assume a constant characteristic particle size, however our retrievals find that effective radii in the arctic can be much larger than the assumed sizes and this varies considerably. And lastly, we will examine how all of these issues change in import and impact on the heating rate, both diurnally and seasonally.

(4) An element in last years (year 4) work plan was to: *"Initiate comparisons between the surface based radar data sets and the retrieved cloud products produced by the MODIS and CERES science teams. Comparisons were to have been made between cloud fraction, cloud optical depth, and cloud top height/pressure/temperature to a number of existing satellite-based detection algorithms including CASPR, TOVS, and the AVHRR-based methods utilized by Patrick Minnis at NASA Langley. ISCCP data sets will be used to put the NSA data sets in climatological perspective."* This part of the 4th work plan has not yet had significant progress (in part because of the delayed availability of the satellite products) and shall be the major focus of the 5th year work plan.